RESEARCH PAPER

To Study the Correlation of Lipid Profile and Thyroid Profile in Patients with Cardiovascular Disorders

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ABSTRACT
Background
Cardiovascular diseases (CVDs) are a group of disorders of the heart and blood vessels. Thyroid dysfunction, in particular, has been implicated in altering lipid metabolism, vascular function and cardiac performance, thereby influencing cardiovascular risk. Hypothyroidism, characterized by low level of serum thyroid hormone which is associated with reduced metabolism, reduced lipolysis, weight gain, reduced cholesterol clearance, and elevated serum cholesterol. Alteration in lipid profile levels is commonly observed in patients with thyroid dysfunction. Thus the aim of present study is to evaluate the correlation between thyroid function and lipid profile in patients diagnosed with cardiovascular disorders.
Objectives
To assess the thyroid profile (T3, T4, TSH) and lipid profile in patients with Cardiovascular disorder (CVD) and to correlate TSH with lipid profile in patient with CVD.
Material and Methods
A Hospital based case-control study was conducted at Shri Guru Ram Rai Institute of Medical and Health Sciences, Dehradun. Total 160 participants were enrolled from Shri Mahant Indresh Hospital, Dehradun. Serum level of thyroid profile (T3, T4, TSH) and lipid profile were measured by using Vitros 5600/7600.
Result
The concentration of TSH is significantly increased in patient with CVDs as compare to control group but we did not found a significant difference in concentration of T3 and T4 in patient with CVDs as compare to control group. The serum level of total cholesterol, triglycerides, VLDL-C and LDL-C are increased in patient with CVDs as compare to control group. The serum level of HDL-C decreased in patient with CVDs as compare to control group. This study revealed that TSH showed a positive correlation with TC, TG, LDL-C, and VLDL-C, while a negative correlation was observed with HDL-C. These findings suggest that progressive thyroid dysfunction is directly linked to worsening lipid abnormalities.
Conclusion
It may be concluded the routine screening and management for thyroid dysfunction in patients with cardiovascular disease is important. It may be helpful in associated dyslipidaemia management, reduce the progression of atherosclerosis and ultimately reduce the rate of cardiovascular disorders and heart failure.
Keywords: Cardiovascular Disorders, Atherosclerosis, coronary artery disease, arterial hypertension, Lipid Profile, Thyroid Profile.
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Introduction: Cardiovascular disorders (CVDs) comprise a group of diseases involving the heart and blood vessels, including coronary artery disease (CAD) **[1, 2]**. They are the leading causes of morbidity and mortality globally. According to the World Health Organisation (WHO), an estimated

17.9 million people die each year due to CVDs, accounting for 32% of all global deaths (WHO, 2023) **[3]**.Among all non-communicable diseases (NCDs), which comprises around 63% of all death, 27% of these all fatalities is due to only CVDs in countries like India according to WHO in 2025 **[4].**

Multiple risk factors contribute to the development of cardiovascular disorders. These include modifiable factors such as hypertension, dyslipidaemia, smoking, diabetes mellitus and obesity, as well as non-modifiable ones like age, gender and genetic predisposition **[5, 6].** The underlying pathophysiology of cardiovascular disorders often involves atherosclerosis, characterised by the accumulation of lipids and fibrous elements along with inflammation in the large arteries**[7].**Atherosclerotic plaque development leads to narrowing and stiffening of the arteries, ultimately reducing blood flow and limits oxygen supply to tissues and organs (ischaemia). In some cases, the rupture of a plaque can trigger thrombus formation, resulting in acute events like myocardial infarction or ischemic stroke or sudden cardiac death if left untreated **[8, 9, 10]**.

Recent research has also highlighted the link between metabolic disorders and cardiovascular diseases**[11].** Thyroid dysfunction, in particular, has been implicated in altering lipid metabolism, vascular function and cardiac performance, thereby influencing cardiovascular risk **[12, 13]**. Dyslipidaemia is characterised by increased total cholesterol, triacylglycerol (TG), low-density lipoprotein, and low HDL cholesterol**.** This is associated with increased risk for CAD **[14, 15]**.Thyroid dysfunction—especially overt or subclinical hypothyroidism—amplifies this cascade. Reduced thyroid-hormone activity slows lipid metabolism, lowers LDL-receptor expression, and diminishes hepatic clearance of cholesterol, leading to elevated total cholesterol, LDL cholesterol, and triglycerides. Concomitantly, hypothyroidism induces endothelial dysfunction, increases systemic vascular resistance, and sustains an inflammatory milieu, all of which contribute to atherogenesis **[16].** Thus, thyroid imbalance indirectly yet decisively accelerates the formation and progression of atherosclerotic plaques, thereby heightening the incidence and severity of CAD.

Excess production of thyroid hormone leads to hyperthyroidism, while diminished production leads to hypothyroidism. Hypothyroidism is one of the most commonly occurring thyroid disorders worldwide which is characterised by low serum thyroid hormone levels (T3, T4) and hyper secretion of pituitary TSH **[17].**It is associated with reduced lipolysis, weight gain, reduced cholesterol clearance, and elevated serum cholesterol. These all result in dyslipidaemia, which is a major risk factor for CAD **[18]**.Subclinical hypothyroidism has been independently associated with increased cardiovascular risk, particularly in patients with heart failure. It contributes to adverse outcomes such as dyslipidaemia, hypertension, atherosclerosis and even all-cause mortality. Subclinical hypothyroidism is a condition characterized by elevated serum thyroid-stimulating hormone (TSH) levels with normal circulating levels of free thyroxin (T4) and triiodothyronine (T3) **[19].**

Research suggested that subclinical hypothyroidism may lead to alterations in lipid metabolism, endothelial dysfunction, and increased systemic vascular resistance, all of which contribute to atherosclerosis and cardiovascular risk. Unlike subclinical hypothyroidism, overt hypothyroidism presents with both biochemical abnormalities and clear clinical manifestations. It is marked by significantly elevated serum TSH levels accompanied by reduced concentrations of circulating thyroid hormones (T3 and T4) **[12].** This overt hormonal deficiency leads to more profound metabolic disturbances, including altered lipid metabolism. Consequently, overt hypothyroidism is strongly associated with elevated total and LDL cholesterol levels, which contribute to an increased risk of atherosclerosis and cardiovascular disease **[13].**

Moreover, both subclinical hypothyroidisms are associated with dyslipidaemia and CVDs in previous studies**.** Thus, it is essential to reduce the rate of cardiovascular disorders and heart failure and to improve the quality of life. Given the global burden and complexity of cardiovascular disorders, continuous research and awareness are essential to reduce disease incidence and improve patient outcomes. Therefore, our study aims to investigate the correlation between lipid profile and Thyroid Profile in patients with cardiovascular disorders.

MATERIALS AND METHODOLOGY:

The total number of 160 subjects included in this study, in which 80 were CVD patients and 80 were healthy control between the ages of 25-65 years. Patients & healthy subjects were enrolled from Shri Mahant Indiresh Hospital, Dehradun. Informed consent was taken from each participant. Blood collection was done after 12 hours overnight fast, approximately 5 ml of fasting venous blood was collected aseptically from each subject using a sterile disposable syringe.The samples were transferred to plain vacationers, allowed to clot, and then centrifuged at 3500 rpm for 10 - 15 minutes.Serum and plasma with lipemia and hemolysis was excluded in this study. The separated serum sample was used for the analysis of lipid profile (total cholesterol (TC), triglycerides (TG), HDL - cholesterol, LDL-cholesterol and VLDL-cholesterol) and Thyroid profile (free T3, free T4 and TSH). The analysis of sample was done at Department of Biochemistry of Shri Mahant Indiresh Hospital, Dehradun by using fully auto-analyzer VITROS 5600 or VITROS 7600 by standardized method. Exclusion criteria for participants who have chronic kidney or liver disease, malignancy current or within past 5 years, individuals with any past history of thyroid disorders such as hypothyroidism or hyperthyroidism, individual with any disorder of pituitary gland and hypothalamus, healthy persons currently receiving any lipid lowering drugs, pregnant women were also excluded from this study.

Statistical Analysis: The results were expressed as mean ± standard deviation (SD).Data were analyzed by using SPSS software (SPSS® for Windows ® 10.0).Comparisons of all parameters between healthy control and CVD patients were analyzed using the student's t-test and pearson's correlation coefficient to calculate the p-value. Statistically significance was accepted at $p< 0.0001$. We used SPSS software (SPSS® for Windows ® 10.0) to find out correlation coefficient between TSH and all parameters of lipid profile CVD patients and healthy control by plotting a scattered diagram according to the distribution of variables.

RESULTS:

The present study was conducted in the Department of Biochemistry and the Central Laboratory at S. G. R. R. I. M. & H. S, Patel Nagar, Dehradun. A total of 160 subjects were included in this study in which 80 patients were cardiovascular disease (CVD) and 80 were healthy control, aged between 25 and 65 years. Data were analyzed by using SPSS software (SPSS® for Windows ® 10.0).

Table 1: The characteristics of the patients like age, gender are presented in Table 1.

Table-1: Gender wise distribution of control and study (CVD) group

Gender	Control group (Age: 25-65 years) (n= 80)	Study (CVD) group (Age: 25-65 years) (n= 80)
Male	47 (59%)	48(60%)
Female	33(41%)	32 (40%)

In Table 1, control group consisted of 47 males (59%) and 33 females (41%). In the CVD group, there were 48 (60%) males and 32 (40%) females.

Out of 80 patients, 36 (45%) had normal thyroid function, 32 (40%) showed subclinical thyroid dysfunction, and 12 (15%) had overt thyroid dysfunction. This indicates that subclinical cases were almost as common as normal cases, while overt cases were comparatively fewer.

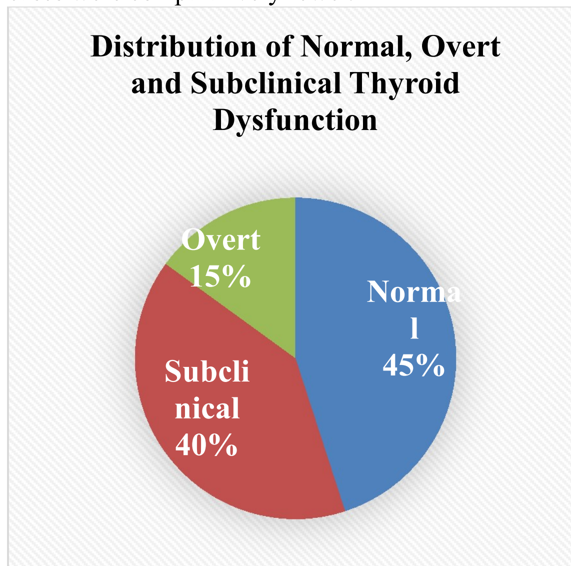
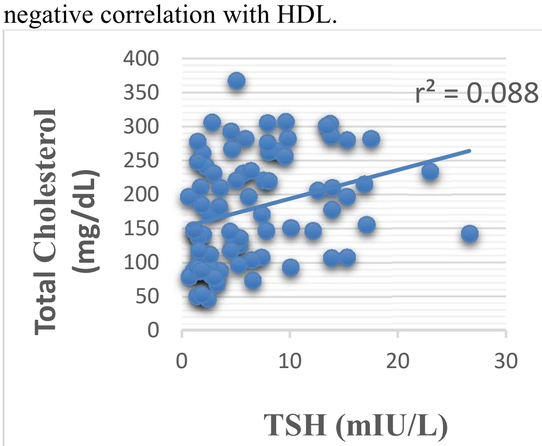


Table-2: Comparison of Biochemical Parameters between CVD patients and Control Group

In Table 2, the mean and standard deviation (SD) values for free T3 in CVD patients was 4.73 ± 1.28 pmol/L and in the control group was 4.68 ± 1.03 pmol/L, statistically not significant (p = 0.78). The mean and standard deviation (SD)valuesfor freeT$_4$ level in CVD patients was 16.86 ± 6.72 pmol/L and in the control group was 15.82 ± 3.23 pmol/L, statistically not significant (p = 0.214). The mean and standard deviation (SD) values for TSH level in CVD patients was 6.62 ± 5.53 mIU/ml and in control group was 2.04 ± 1.20 mIU/L, Statistically significant (p = 0.0001***). The mean and standard deviation (SD) values for total cholesterol in CVD patients was 169.33 ± 51.61 mg/dl and in controls was 158.06 ± 22.28 mg/dl, statistically not significant (p = 0.074). The mean and standard deviation (SD) values for triglyceride (TG) in CVD patients was 179.37 ± 79.0 mg/dl and in control group was 105.36± 34.25 mg/dl, statistically significant (p = 0.0001***). The mean and standard deviation (SD) values for HDL in CVD patients was 40.28 ± 13.63 mg/dl and in control group was 48.10 ± 7.64 mg/dl, statistically significant (p = 0.0001***). The mean and standard deviation (SD) values for VLDL in CVD patients was 35.56 ± 16.43 mg/dl and in control group was 19.47 ± 5.30 mg/dl , statistically significant (p = 0.0001***). The mean and standard deviation (SD) values for LDL in CVD patients was 89.43 ± 41.19 mg/dl and in control group was 82.66 ± 21.60 mg/dl, statistically notsignificant (p = 0.19).

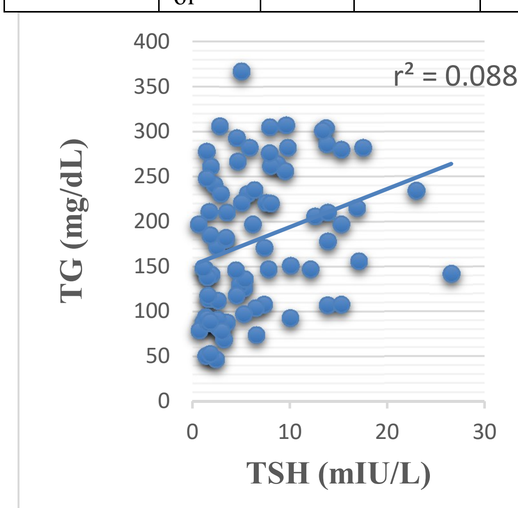
In cardiovascular patients, TSH shows positive correlation with total cholesterol, triglyceride, VLDL and LDL while negative correlation with HDL. In healthy control, TSH shows positive correlation with total cholesterol, triglyceride, VLDL and LDL while negative correlation with HDL.



Correlation of TSH with Total Cholesterol in CVD patients

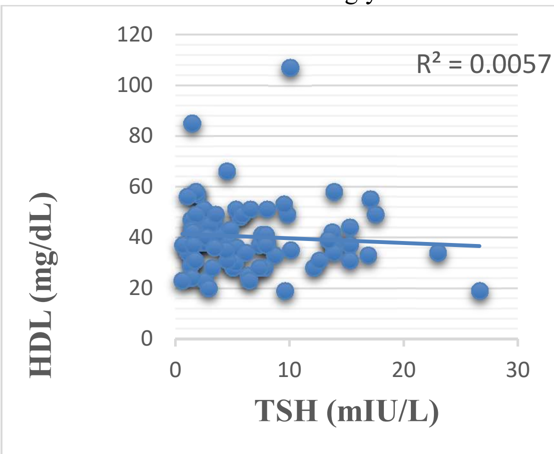
Scatter diagram shows correlation between TSH and Total Cholesterol in CVD patients. r- Value 0.1364 shows a weakly positive correlation between TSH and Total Cholesterol.

Parameter	Group	Mean	Standard Deviation	p-value
Free T$_3$ (pmol/L)	CVD	4.73	1.28	0.78
	Control	4.68	1.03	
Free T$_4$ (pmol/L)	CVD	16.86	6.72	0.214
	Control	15.82	3.23	
TSH (mIU/L)	CVD	6.62	5.53	0.0001***
	Control	2.04	1.20	
Total Cholesterol (mg/dl)	CVD	169.33	51.61	0.074
	Control	158.06	22.28	
Triglycerides (mg/dl)	CVD	179.37	79.0	0.0001***
	Control	105.36	34.25	
HDL-C (mg/dl)	CVD	40.28	13.63	0.0001***
	Control	48.10	7.64	
VLDL-C (mg/dl)	CVD	35.56	16.43	0.0001***
	Control	19.47	5.30	
LDL-C (mg/dl)	CVD	89.43	41.19	0.19
	Control	82.66	21.60	



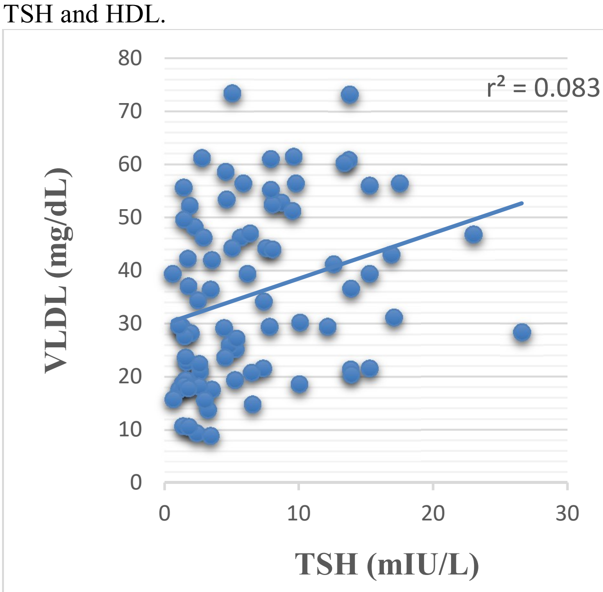
Correlation of TSH with TG in CVD patients

A scatter diagram shows the correlation between TSH (mIU/L) and Total Cholesterol (mg/dl) in CVD patients. The r- value 0.088 shows a weakly positive correlation between TSH and triglycerides.



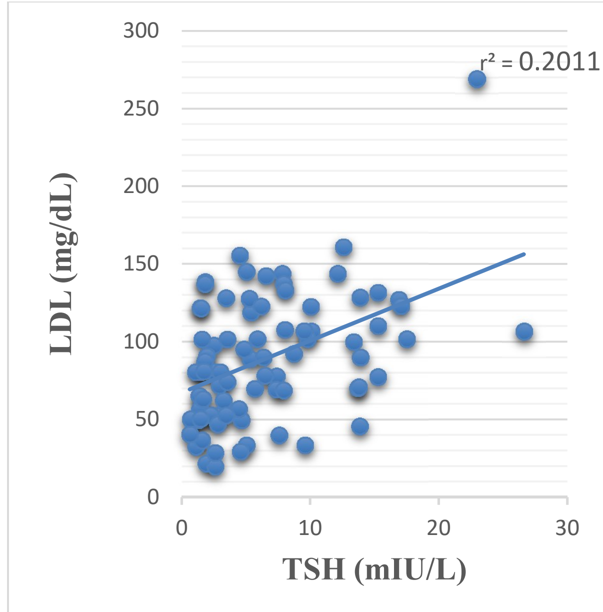
Correlation of TSH with HDL in CVD patients

The scatter diagram shows a correlation between TSH (mIU/L) and HDL (mg/dl) in CVD patients. The r-value 0.0057 shows a negative correlation between TSH and HDL.



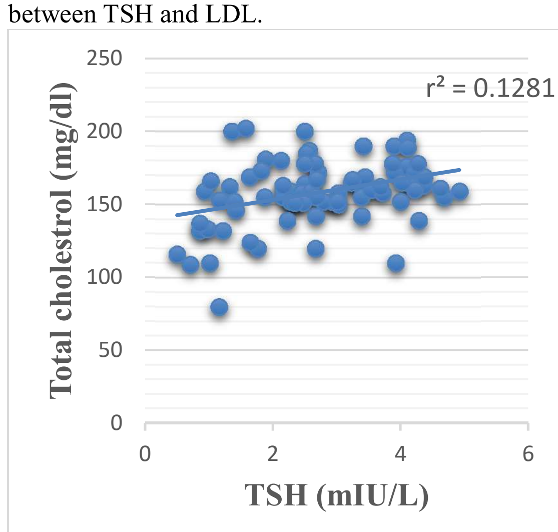
Correlation of TSH with Total VLDL in CVD patients

The scatter diagram shows a correlation between TSH (mIU/L) and VLDL (mg/dl) in CVD patients. The r-value 0.083 shows a weakly positive correlation between TSH and VLDL.



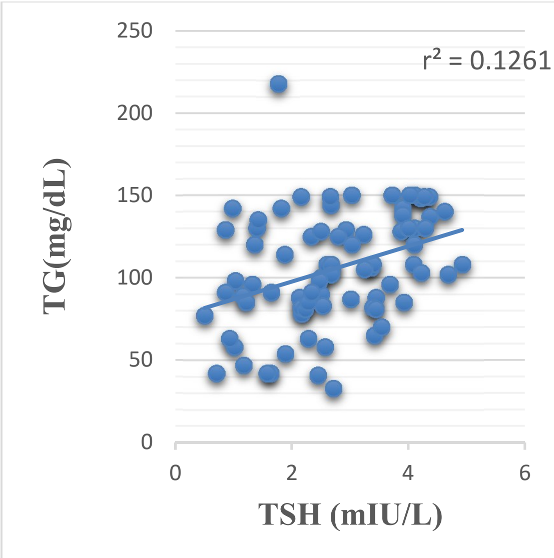
Correlation of TSH with LDL in CVD patients

The scatter diagram shows a correlation between TSH (mIU/L)and LDL (mg/dl) in CVD patients. The r- value 0.2011 shows a weakly positive correlation between TSH and LDL.



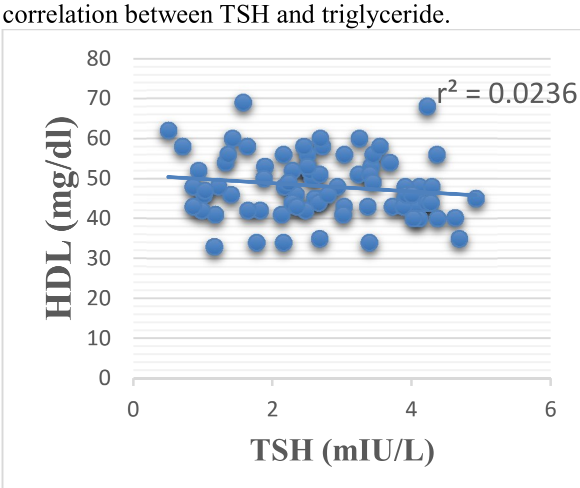
Correlation of TSH with Total Cholesterol in healthy controls

The scatter diagram shows a correlation between TSH (mIU/L)and Total Cholesterol (mg/dl) in control patients. The r-value 0.1281 shows a weakly positive correlation between TSH and Total Cholesterol.



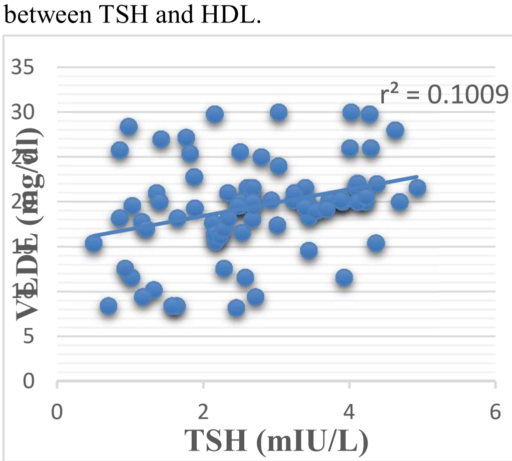
Correlation of TSH with T.G in healthy controls

The scatter diagram shows a correlation between TSH (mIU/L) and T.G (mg/dl) in control patients. The r-value 0.1261 shows a weakly positive correlation between TSH and triglyceride.



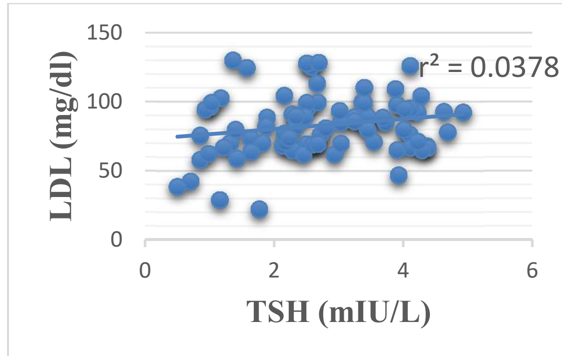
Correlation of TSH with HDL in healthy controls

The scatter diagram shows a correlation between TSH (mIU/L) and HDL (mg/dl) in control patients. The r value 0.0236 shows a negative correlation between TSH and HDL.



Correlation of TSH with VLDL in healthy controls

The scatter diagram shows a correlation between TSH (mIU/L) and VLDL(mg/dl) in control patients. The r- value 0.1009 shows a weakly positive correlation between TSH and VLDL.



Correlation of TSH with LDL in healthy controls

The scatter diagram shows a correlation between TSH (mIU/L) and LDL (mg/dl) in control patients. The r-value 0.0378 shows a weakly positive correlation between TSH and LDL.

Correlation analysis in this study revealed that TSH showed a positive correlation with TC, TG, LDL-C, and VLDL-C, while a negative correlation was observed with HDL-C. These findings suggest that progressive thyroid dysfunction is directly linked to worsening lipid abnormalities. Similar correlations were reported by **Canaris et al. (2000), Pucci et al. (2000), and Rizos et al. (2011)**.

Discussion:

Cardiovascular diseases (CVDs) are the leading cause of mortality globally, responsible for a significant number of deaths and disabilities. In 2021 alone, CVDs accounted for 20.5 million deaths, comprising approximately one-third of all global deaths [**20].**

The World Health Organization (WHO) estimates that in 2019, approximately 17.9 million individuals succumbed to CVDs, constituting 32% of all deaths worldwide [**21].** These include conditions like chest pain, in severe cases, heart attacks, coronary artery disease (CAD), ischemic stroke, and myocardial infarction (MI). In India, the development of CVD is influenced by multiple risk factors such as dyslipidaemia, hypertension (HT), diabetes, obesity, smoking, poor diet, and sedentary lifestyle [**22].** Cardiovascular diseases (CVDs) are a group of disorders of the heart and blood vessels [**23].** CVDs are chronic diseases that gradually evolve throughout life and remain asymptomatic for a long time **[24]**. There is a significant link between lipid problems and the development of CVDs, including atherosclerosis, which is the primary pathological process responsible for most cardiovascular events. Dyslipidemia refers to a group of lipid abnormalities, which include high levels of low-density lipoprotein cholesterol (LDL-C), low levels of high-density lipoprotein cholesterol (HDL-C), and elevated triglycerides. These lipid abnormalities create the conditions for the development of atherosclerotic plaques in the walls of arteries, which are closely connected to the beginning and advancement of CVDs **[25].**

Hypothyroidism, both overt and subclinical, is commonly associated with dyslipidaemia [**13**]. Reduced thyroid-hormone activity slows lipid metabolism, reduced lipolysis and diminishes hepatic clearance of cholesterol, leading to elevated total cholesterol, LDL cholesterol, and triglycerides **[26].** Hypothyroidism induces endothelial dysfunction, increases systemic vascular resistance, and sustains an inflammatory milieu, all of which contribute to atherogenesis **[27].** Thyroid hormones are essential for the proper functioning of the cardiovascular system, as thyroid dysfunction indirectly contributes to cardiovascular disorders **[16].** Thus, in the present study, we assess the serum level of Thyroid profile in CVD patients and correlate it with lipid profile and compare the CVD patients with healthy controls to understand the disturbance in serum levels of thyroid profile and lipid profile caused by to diseased condition.

In our study, the serum free T3 level in CVD patients was 4.73 ± 1.28 pmol/L, while in healthy controls it was 4.68 ± 1.03 pmol/L. The difference was not statistically significant (p = 0.78), suggesting that overt thyroid hormone deficiency was not common among the study participants. Similar findings were reported by **Canaris et al. (2008)**, who observed that early thyroid dysfunction may not always show significant changes in circulating T3 levels, and by **Pucci et al. (2009)**, who highlighted that thyroid hormones often influence lipid metabolism without marked alterations in serum T3 concentrations during subclinical stages**[28, 29].**

The serum free T4 level in CVD patients (16.86 ± 6.72 pmol/L) when compared to 15.82 ± 3.23 pmol/L in healthy controls, with no statistically significant difference between the groups (p = 0.214). This again indicates that overt thyroid hormone deficiency was not commonly present. **Rizos et al. (2011)** and **Jung CH et al. (2008)** who also reported that mild thyroid dysfunction may be associated with metabolic disturbances despite near-normal T4 levels [**13, 30].**

However, TSH levels were found to be significantly higher in CVD patients (6.62 ± 5.53 µIU/ml) compared to healthy controls (2.04 ± 1.20 µIU/ml; p = 0.0001***). This indicates a higher prevalence of subclinical hypothyroidism among CVD patients. **Cappola AR et al. (2006)** reported that subclinical hypothyroidism increases the risk of coronary heart disease and cardiovascular mortality. **Fotedar Set al. (2025)** also found elevated TSH levels in CAD patients, correlating positively with lipid abnormalities **[31, 32].**

The mean total cholesterol (TC) level was slightly higher in CVD patients (169.33 ± 51.61 mg/dl) compared to healthy controls (158.06 ± 22.28 mg/dl), though the difference was not statistically significant (p = 0.068). Similar findings were reported by **Ibrahim MM et al. (2013)** and **Fotedar S et al. (2025)** who observed increased cholesterol levels in hypothyroid CVD patients, although the degree of association varied with thyroid status [**32, 33].**

A significant rise in TG was observed in CVD patients (179.37 ± 79.0 mg/dl) compared to controls (105.36 ± 34.25 mg/dl; p = 0.0001***). This is consistent with **Kebamo TE et al. (2025)** and **Benny PD et al. (2023)**, who reported hypertriglyceridemia in hypothyroid patients due to reduced lipoprotein lipase activity and delayed TG clearance [**34, 35].**

HDL-C levels were significantly lower in CVD patients (40.28 ± 13.63 mg/dl) compared to controls (48.10 ± 7.64 mg/dl; p = 0.0001***). Reduced HDL impairs reverse cholesterol transport and increases susceptibility to atherosclerosis**. Rizos et al. (2011)** and **Ghodpage D et al. (2025)** also demonstrated that thyroid dysfunction is associated with reduced HDL-C, further increasing cardiovascular risk [**13, 36].**

The mean VLDL-C was significantly higher in CVD patients (35.56 ± 16.43 mg/dL) compared to controls (19.47 ± 5.30 mg/dl; p = 0.0001***). **Fotedar S et al. (2025)** and **Kebamo TE et al. (2025)** reported similar findings, emphasising the contribution of thyroid dysfunction to increased hepatic VLDL production [**32, 34].**

The LDL-C was higher in CVD patients (89.43 ± 41.19 mg/dl) compared to healthy controls (82.66 ± 21.60 mg/dl), although the difference was not statistically significant (p = 0.19). Despite this, even moderate increases in LDL-C are clinically relevant, as **Ghodpage D et al. (2025)** established LDL-C as a causal factor in the development of atherosclerotic cardiovascular disease. Similarly, **Kumar A et al. (2024)** reported a positive correlation between higher TSH levels and increased LDL-C concentrations in ischemic heart disease patients **[36, 37]**

Conclusion:

The result of present study highlights the correlation between thyroid function and lipid profile in patients with cardiovascular disease (CVD) as compared to healthy controls. The results demonstrated that serum free T3 and free T4 levels did not differ significantly in CVD patients as compared to control. The TSH was markedly elevated in CVD patients as compared to control. Analysis of lipid profile revealed that CVD patients had significantly higher levels of triglycerides (TG) and very-low-density lipoprotein cholesterol (VLDL-C) along with significantly reduced levels of high-density lipoprotein cholesterol (HDL-C), compared to healthy controls. Total cholesterol (TC) and low-density lipoprotein cholesterol (LDL-C) were higher in CVD patients, though the differences were not statistically significant. In cardiovascular patients, TSH shows positive correlation with total cholesterol, triglyceride, VLDL and LDL while negative correlation with HDL. In healthy control, TSH shows positive correlation with total cholesterol, triglyceride, VLDL and LDL while negative correlation with HDL. Moreover we found that subclinical hypothyroidism is more common in CVD patients. However we also found overt hypothyroidism. Thus the study highlights the importance of routine screening for thyroid dysfunction in patients with cardiovascular disease. Early detection and management of thyroid abnormalities may be helpful in associated dyslipidaemia management, reduce the progression of atherosclerosis and ultimately reduce the rate of cardiovascular disorders and heart failure.

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